

PCT/GB02/05937

Sheet No. 5

**Box No. VIII (iv) DECLARATION: INVENTORSHIP** (only for the purposes of the designation of the United States of America)  
*The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.*

**Declaration of inventorship (Rules 4.17(iv) and 51bis.1(a)(iv))  
 for the purposes of the designation of the United States of America:**

I hereby declare that I believe I am the original, first and sole (if only one inventor is listed below) or joint (if more than one inventor is listed below) inventor of the subject matter which is claimed and for which a patent is sought.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/..... (if furnishing declaration pursuant to Rule 26ter).

I hereby declare that my residence, mailing address, and citizenship are as stated next to my name.

I hereby state that I have reviewed and understand the contents of the above-identified international application, including the claims of said application. I have identified in the request of said application, in compliance with PCT Rule 4.10, any claim to foreign priority, and I have identified below, under the heading "Prior Applications," by application number, country or Member of the World Trade Organization, day, month and year of filing, any application for a patent or inventor's certificate filed in a country other than the United States of America, including any PCT international application designating at least one country other than the United States of America, having a filing date before that of the application on which foreign priority is claimed.

Prior Applications: Filing Date: 9th January 2002. Application No: GB0200369.7. (Our Ref: IP/P2995) .....

I hereby acknowledge the duty to disclose information that is known by me to be material to patentability as defined by 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the PCT international filing date of the continuation-in-part application.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name: LOWERY Brett Robert

Residence: United Kingdom

(city and either US state, if applicable, or country)

Mailing Address: QINETIQ LIMITED, Cody Technology Park

Ively Road, Farnborough, Hampshire, GU14 0LX

Citizenship: GB

Inventor's Signature: B. Lowery  
 (if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)

Date: 3/2/03  
 (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)

Name: PACKARD Thomas James (Dr)

Residence: United Kingdom

(city and either US state, if applicable, or country)

Mailing Address: DSTL Chertsey, Chobham Lane, Chertsey

Surrey, KT16 0EE

Citizenship: GB

Inventor's Signature: [Signature]  
 (if not contained in the request, or if declaration is corrected or added under Rule 26ter after the filing of the international application. The signature must be that of the inventor, not that of the agent)

DSTL, Porton Down  
Salisbury  
Wiltshire SP4 0TQ  
 Date: 3 Feb 2003  
 (of signature which is not contained in the request, or of the declaration that is corrected or added under Rule 26ter after the filing of the international application)

**Best Available Copy**

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

# PATENT COOPERATION TREATY

CMF

From the INTERNATIONAL SEARCHING AUTHORITY

## PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT  
OR THE DECLARATION

(PCT Rule 44.1)

To:  
IP QINETIQ FORMALITIES  
Cody Technology Park  
Attn. Farrar, Chris  
A4 Building, Room G016  
Ively Road, Farnborough  
Hampshire GU14 0LX  
UNITED KINGDOM

Date of mailing (day/month/year)	25/04/2003
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Applicant's or agent's file reference IP/P2995W0D	ID	FOR FURTHER ACTION      See paragraphs 1 and 4 below
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International application No. PCT/GB 02/05937	International filing date (day/month/year)      30/12/2002
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Applicant  QINETIQ LIMITED	25 APR 2003
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1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19.**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.


☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

<p>Name and mailing address of the International Searching Authority</p> <div style="text-align: center;">  </div> <p>European Patent Office, P.B. 5818 Patentaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016</p>	<p>Authorized officer</p> <p style="text-align: center;">Louis Kainde</p>
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## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

## NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

### "Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

### Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

### Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>IP/P2995W0D</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 02/ 05937</b>	International filing date (day/month/year) <b>30/12/2002</b>	(Earliest) Priority Date (day/month/year) <b>09/01/2002</b>
Applicant <b>QINETIQ LIMITED</b>		
<p>This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.</p> <p>This International Search Report consists of a total of <u>5</u> sheets.  <input checked="" type="checkbox"/> It is also accompanied by a copy of each prior art document cited in this report.</p>		
<p><b>1. Basis of the report</b></p> <p>a. With regard to the <b>language</b>, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.</p> <p><input type="checkbox"/> the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).</p> <p>b. With regard to any <b>nucleotide and/or amino acid sequence</b> disclosed in the international application, the international search was carried out on the basis of the sequence listing:</p> <p><input type="checkbox"/> contained in the international application in written form.</p> <p><input type="checkbox"/> filed together with the international application in computer readable form.</p> <p><input type="checkbox"/> furnished subsequently to this Authority in written form.</p> <p><input type="checkbox"/> furnished subsequently to this Authority in computer readable form.</p> <p><input type="checkbox"/> the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.</p> <p><input type="checkbox"/> the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.</p> <p>2. <input type="checkbox"/> <b>Certain claims were found unsearchable</b> (See Box I).</p> <p>3. <input type="checkbox"/> <b>Unity of invention is lacking</b> (see Box II).</p> <p>4. With regard to the <b>title</b>,</p> <p><input checked="" type="checkbox"/> the text is approved as submitted by the applicant.</p> <p><input type="checkbox"/> the text has been established by this Authority to read as follows:</p> <p>5. With regard to the <b>abstract</b>,</p> <p><input type="checkbox"/> the text is approved as submitted by the applicant.</p> <p><input checked="" type="checkbox"/> the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.</p> <p>6. The figure of the <b>drawings</b> to be published with the abstract is Figure No. <u>2</u></p> <p><input checked="" type="checkbox"/> as suggested by the applicant. <input type="checkbox"/> None of the figures.</p> <p><input type="checkbox"/> because the applicant failed to suggest a figure.</p> <p><input type="checkbox"/> because this figure better characterizes the invention.</p>		

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 02/05937

**Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)**

A mineplough (1) which is designed to be resilient to exploding mines comprises one or more blades set at an angle to the general direction of movement of the plough so as to deflect lifted earth to one or both sides of the plough and having tines (5b-5j) arranged so as to lift earth ahead of the blade in the direction of travel thereof, depth control means for controlling the depth of cut of the tines and at least two linkages to connect the blade to a suitable carrier vehicle for the mineplough. The blade is comprised of a number of intersecting strong metal plates (2a-2j; 3a-3d) whose planes lie substantially parallel to the direction of travel of the mineplough and which define relatively narrow open channels therebetween so as to allow venting of any explosion caused by a mine exploding in contact with the blade. The blade may be faced with a relatively thin metal or plastics sheet (7) to absorb some of the force of any explosion and further protection is provided by the fact that each linkage contains at least one crushable element (8) capable of absorbing blast energy.

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 02/05937

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 F41H11/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F41H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 189 243 A (HAMBRIC) 23 February 1993 (1993-02-23) column 4, line 39 - line 54 column 5, line 8 - line 12; figures 3,4 ---	1-4,7,8, 11
Y	WO 99 46554 A (BOFORS) 16 September 1999 (1999-09-16) page 8, line 22 - line 26; figures 2,4-6 ---	1-4,7,8, 11
A	US 5 198 608 A (CAHILL ET AL.) 30 March 1993 (1993-03-30) column 6, line 44 - line 65 column 8, line 3 - line 17; figures 1,9,11 ---	1-4,7,8, 11
A	US 5 313 868 A (WOLF) 24 May 1994 (1994-05-24) column 5, line 64 -column 6, line 14; claims 7,15; figure 5 ---	1,9,10
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

15 April 2003

Date of mailing of the international search report

25/04/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Giesen, M

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/05937

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 453 011 B (BOFORS AB) 4 January 1988 (1988-01-04) figures 4-6 ---	1-8
A,P	WO 02 066919 A (QINETIQ) 29 August 2002 (2002-08-29) page 3, line 11 - line 13 -----	1



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 02/05937

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5189243	A	23-02-1993	NONE	
WO 9946554	A	16-09-1999	SE 511676 C2 EP 1062474 A1 SE 9800765 A WO 9946554 A1	08-11-1999 27-12-2000 11-09-1999 16-09-1999
US 5198608	A	30-03-1993	NONE	
US 5313868	A	24-05-1994	WO 9532402 A1 AU 7243294 A	30-11-1995 18-12-1995
SE 453011	B	04-01-1988	SE 8303453 A	17-12-1984
WO 02066919	A	29-08-2002	GB 2372235 A WO 02066919 A1 WO 02066920 A1	21-08-2002 29-08-2002 29-08-2002

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
17 July 2003 (17.07.2003)

PCT

(10) International Publication Number  
**WO 03/058152 A1**(51) International Patent Classification<sup>7</sup>: **F41H 11/16**(21) International Application Number: **PCT/GB02/05937**(22) International Filing Date:  
30 December 2002 (30.12.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0200369.7 9 January 2002 (09.01.2002) GB(71) Applicant (for all designated States except US): **QINETIQ LIMITED** [GB/GB]; Registered Office, 85 Buckingham Gate, London SW1E 6PD (GB).

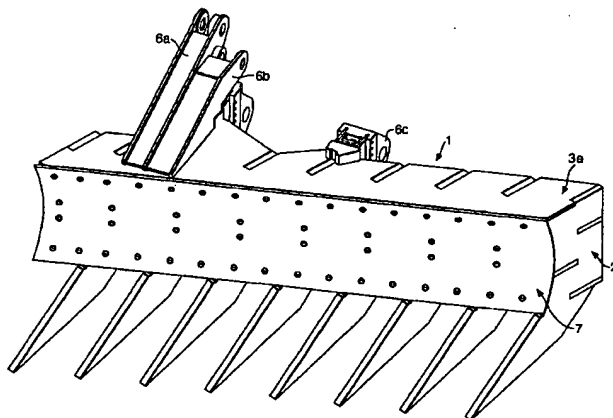
(72) Inventors; and

(75) Inventors/Applicants (for US only): **LOWERY, Brett, Robert** [GB/GB]; QinetiQ Limited, Cody Technology Park, Farnborough, Hampshire GU14 0LX (GB). **PACKARD, Thomas, James** [GB/GB]; DSTL Chertsey, Chobham Lane, Chertsey, Surrey KT16 0EE (GB).(74) Agent: **FARRAR, Chris**; IP QinetiQ Formalities, Cody Technology Park, A4 Building, Ively Road, Farnborough, Hampshire GU14 0LX (GB).(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv)) for US only

[Continued on next page]

(54) Title: **MINEPLOUGH**

(57) Abstract: A mineplough (1) which is designed to be resilient to exploding mines comprises one or more blades set at an angle to the general direction of movement of the plough so as to deflect lifted earth to one or both sides of the plough and having tines (5b-5j) arranged so as to lift earth ahead of the blade in the direction of travel thereof, depth control means for controlling the depth of cut of the tines and at least two linkages to connect the blade to a suitable carrier vehicle for the mineplough. The blade is comprised of a number of intersecting strong metal plates (2a-2j; 3a-3d) whose planes lie substantially parallel to the direction of travel of the mineplough and which define relatively narrow open channels therebetween so as to allow venting of any explosion caused by a mine exploding in contact with the blade. The blade may be faced with a relatively thin metal or plastics sheet (7) to absorb some of the force of any explosion and further protection is provided by the fact that each linkage contains at least one crushable element (8) capable of absorbing blast energy.

WO 03/058152 A1



**Published:**

— with international search report

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

Mineplough

The present invention relates to a novel form of blade for a mineplough.

A mineplough may be defined as the apparatus fitted to a (preferably robust) vehicle so as to create a system for effecting clearance of a path through a minefield. In particular this mode of mine clearance is appropriate for use in a wartime situation where a rapid clearance of anti-tank mines is operationally vital because it is recognised that, in these circumstances, some damage is likely to be sustained by at least the mineplough part of the system.

The main mechanical components of a mineplough are:

- i) a blade which comprises:
  - a) tines which are teeth mounted on the blade and which cut into the ground so as to lift the earth and any buried mines; and
  - b) the mouldboard which is the part of the blade that pushes the lifted earth and mines to the side of the vehicle path to clear a lane for following traffic;
- ii) a linkage system which is the mechanism connecting the plough to the carrier vehicle; and
- iii) a depth control system, the function of which is to try and ensure that the tines maintain a constant depth of cut. It usually comprises ground following skids which react against the vertical forces produced during ploughing.

In clearing a path through a major minefield it is recognised that upto 5 mines in total may have to be cleared and if, for example, these are fitted with anti-disturbance fuzing, this may mean upto 5 mines exploding during the clearing operation. To achieve a speedy clearance it is desirable that only one mineplough be actually involved in the operation but with current designs of mineplough it is not possible to attain the level of robustness which is required to achieve this.

It is therefore a primary objective of the invention to provide a mineplough which is sufficiently robust to withstand the blast from one or more typical anti-tank mines and yet continue to operate fully effectively.

The particular areas of weakness of current designs lie in the blade itself and most particularly in the linkage between the blade and the carrier vehicle. Accordingly the present invention seeks to provide a mineplough having both a blade and a linkage system which are more resilient towards high shock loadings that can be created by a mine exploding against any part of the mineplough. The invention therefore provides a mineplough which comprises at least one blade element which is set at an angle to the general direction of movement of the plough so as to deflect lifted earth to one or both sides of the plough, tines attached to each said blade element so as to lift earth ahead of that blade element in the direction of travel thereof, depth control means for controlling the depth of cut of the tines and at least two linkages for connecting the mineplough to a suitable carrier vehicle therefor, characterised in that each blade element is comprised of a plurality of intersecting plates whose planes lie substantially parallel to the said direction of travel and which define open channels therebetween and further characterised in that the linkages each contain at least one crushable element capable of absorbing blast shock.

By providing a generally open structure to the mouldboard, the soil and other blast products which are thrown up by a mine exploding ahead of or on contact with a tine are vented through the blade to a high degree thus lowering the loading on the connecting linkage in particular. Further by providing a structure with considerable depth perpendicular to the blade face, the blade is extremely strong and this, coupled with the relatively small surface area which is presented to blast products by the edges of the intersecting plates, means that the blade structure is highly resistant to damage. Typically the depth of the blade in the direction of its travel will be of the order of 150 mm.

The blade channels defined by the intersecting plates should be relatively narrow such that in operation the channels will tend to clog up with soil and hence ploughing action will be maintained. In any event the channels should be of such dimensions as to ensure that any anti-tank mine will be unable to pass through the

blade. Advantageously, however, the vented blade structure is faced on its front surface with a relatively weak covering plate which will act as a normal mouldboard during ploughing but at the same time is able to absorb some of the blast effect should a mine explode adjacent to the blade. However, the covering plate should only be of such strength that it will fail, at least locally, without causing sufficient resistance to the blast as to allow damage to be caused elsewhere in the system (and particularly to the linkage). Although even a first blast may thus cause a substantial disruption to the covering plate (mouldboard) this is likely only to be within an area adjacent to the seat of the explosion and the protective effect of the plate is unlikely to be totally lost even after a number of mines have exploded. Apart from that, as mentioned earlier, even where some of the blade channels through the blade structure have become exposed through degradation of the covering plate, it is likely that, in operation, they will block up with soil and thus a degree of blast resistance will remain even with those channels (as well of course for those areas of the blade which remain protected by undamaged portions of the covering plate).

Advantageously, the structure of the blade comprises a plurality of plates disposed in a substantially vertical arrangement and a further set of plates intersecting these and arranged in a substantially horizontal manner. The spacing of the plates in both dimensions should be such as to ensure that no mine which is likely to be encountered will pass through any of the channels defined by the sets of plates and also such as to ensure that the blade has a sufficient overall strength, while being at the same time sufficiently far apart that the blast venting effect of the blade structure of the invention is maintained. When the plates are arranged in this manner a further advantage of the blade structure of this invention can be achieved by arranging that the tines are formed by an extension of the vertical plates of the blade structure and are thus integral with the rest of the blade. This gives the tines additional strength and resistance to disruption.

Preferably the tines are further strengthened by providing them with bracing pieces which are attached between pairs of adjacent tines. Such bracing members should be relatively thin in the direction of travel of the blade so as to present little or no interference to the blade ploughing action. For the same reason, it is also preferred

that the bracing members be set back from the front edges of the tines to which they are attached.

The two sets of intersecting plates described above may conveniently each have co-operating slots provided in them so that, to assemble a blade element, the respective plates are simply slid together to interlock. The plates are then welded together along the length of each intersection using a large section fillet weld (typically 20mm).

The mineplough may comprise either a single angled blade element or may comprise two blade elements forming a V-shaped blade overall, depending on the size of clearance path required, the nature and effective power of the carrying vehicle used, the nature of the terrain etc.

The linkage of the mineplough of this invention has a crushable element which acts to absorb some of the forces which would otherwise be transmitted from the blade through the linkage to the carrier vehicle and which could otherwise cause the linkage to fail. In particular the pins (termed the "boom arm pins") which allow for motion of the blade at an angle to the direction of travel are likely to suffer from high levels of stress if the blade is subject to a mine exploding at close range and this could cause the pins to fail in shear.

The crushable element suitably comprises a series of substantially U-shaped channel members located ahead of the boom arm pins in the direction of travel of the blade (ie. between the blade and the boom arm pins which the members are intended to protect). The channel members are designed to crush under a loading which is below the shear strength of the boom arm pins. For additional resilience and to achieve better lateral stability of the blade, two sets of channel members could be provided, one of which sets is positioned vertically and the other set of channel members positioned horizontally with respect to the blade. In an alternative arrangement, the channel members could be replaced with a series of short tubes designed to crumple under a shock load and so to act as energy absorbers and it will be readily apparent to the skilled addressee that other means of providing the desired

resilience in the linkage system can be contemplated and are to be understood as falling within the scope of the invention.

The invention will now be further described with reference to the accompanying drawings in which:

Figure 1 is a three dimensional view of a single angled mineplough blade according to the invention;

Figure 2 is a similar view of the same blade as shown in Figure 1, but having a covering plate (mouldboard) attached; and

Figure 3 is a plan view of the same blade as shown in Figure 1 looking from the underside of the blade and showing in more detail a part of the linkage to the carrier vehicle.

In Figure 1 there is shown a mineplough 1 which comprises a set of 9 vertical plates (2a to 2j) and a further set of four horizontally-disposed plates (3a – 3d) constituting the mouldboard. It can be seen that all but one of the vertical plates are extended downwards and forwards of the blade to form a series of tines, 5b – 5j. The plates are conveniently made from steel, for example, Rolled Quenched Tempered (RQT) 701 (a product of Corus Ltd) or a Rolled Homogeneous Armour material. In the case of RQT701 a suitable thickness will be of the order of 20mm for the horizontal plates and 25mm for the vertical plates. Three connecting members 6a, 6b, 6c are attached generally at the rear of the blade for connecting it to the linkage (not shown). (It will be noted that the horizontal plates to which these connecting members are attached are extended outwards towards the connecting members in order to strengthen the plates in the area where the two are connected). A U-shaped channel member 8 is shown generally associated with the connecting member 6c.

In Figure 2 there is shown the same blade as in Figure 1 except that the front face of the blade is now covered with a thin facing plate 7. This plate may be made from steel of 4mm thickness or may comprise a plate of 5 or 10mm thickness of high density polyethylene but it will be readily appreciated that the materials to be used will be dependent to some degree on the size of the openings in the blade structure and on the strength of the linkages among other factors.



Figure 3 shows in greater detail the linkage arrangements of the blade shown in Figures 1 and 2 and the same parts are identified by use of the same numerals as for those Figures. In this drawing the lower ends of vertically-disposed U-shaped channel members 8 associated with both of the connecting members 6b and 6c are shown. Each channel member comprises two channel pieces, 8a and 8b, of which one is housed within the other and provides support once the outer pieces have distorted under a shock load. In this way the channel members can successfully absorb the blast energy from two mines exploding against the blade and protect the linkages from damage.

## Claims

1. A mineplough which comprises at least one blade element which is set at an angle to the general direction of movement of the plough so as to deflect lifted earth to one or both sides of the plough, each said blade element having tines arranged so as to lift earth ahead of that blade element in the direction of travel thereof, depth control means for controlling the depth of cut of the tines and at least two linkages to connect the mineplough to a suitable carrier vehicle therefor, characterised in that each blade element is comprised of a number of intersecting plates whose planes lie substantially parallel to the said direction of travel and which define open channels therebetween and further characterised in that each of the linkages contains at least one crushable element capable of absorbing blast energy.
2. A mineplough as claimed in claim 1 wherein the intersecting plates comprise a first set of plates arranged substantially in the vertical plane and a second set of plates arranged substantially at right angles to the first set.
3. A mineplough as claimed in claim 1 or claim 2 wherein the open channels between the plates are of smaller dimension than any mine which the plough is intended to clear.
4. A mineplough as claimed in any of claims 1 to 3 wherein the open channels have a minimum dimension of the order of 150mm.
5. A mineplough as claimed in any of claims 1 to 4 wherein the front face of the blade is covered with a relatively weak material.
6. A mineplough as claimed in claim 5 wherein the relatively weak material is comprised of a thin sheet of metal or a plastics material.
7. A mineplough as claimed in claim 2 or in any of claims 3 to 6 when dependent on claim 2, wherein the vertically-disposed plates are extended generally downwards and forwards of the blade to form the tines.

8. A mineplough as claimed in claim 7 wherein at least some pairs of adjacent tines are connected together by substantially horizontally disposed bracing members to effect reinforcement of those tines.
9. A mineplough as claimed in any preceding claim wherein the at least one crushable element comprises a substantially U-shaped channel member associated with each linkage and arranged so as to absorb any shock transmitted to it by at least partially collapsing.
10. A mineplough as claimed in claim 9 wherein the channel member comprises two separate U-shaped channel pieces arranged such that one lies within the other and becomes effective to absorb shock only once the outer piece has been deformed.
11. A mineplough substantially as herein described and with reference to the accompanying drawings.

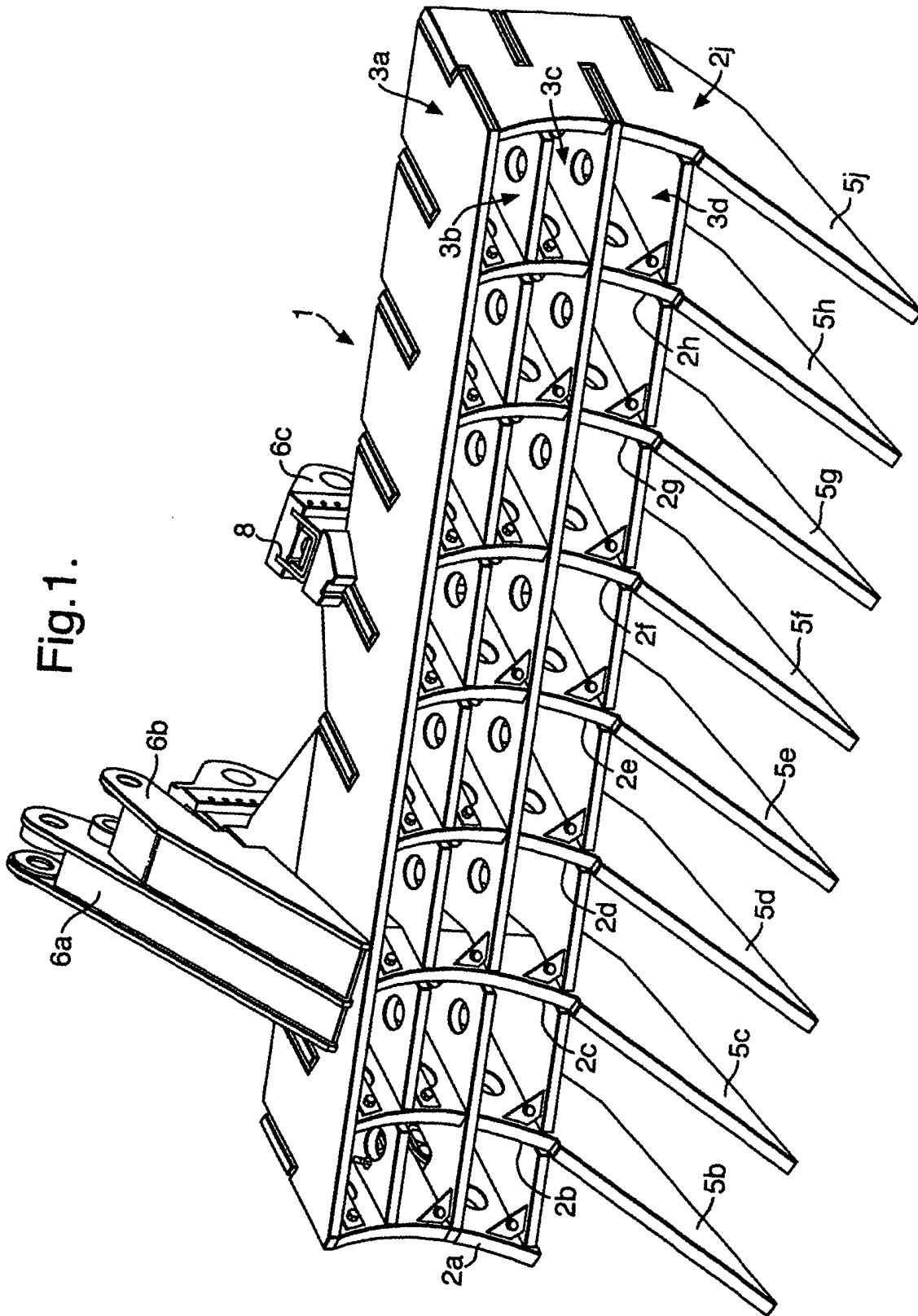


Fig. 1.

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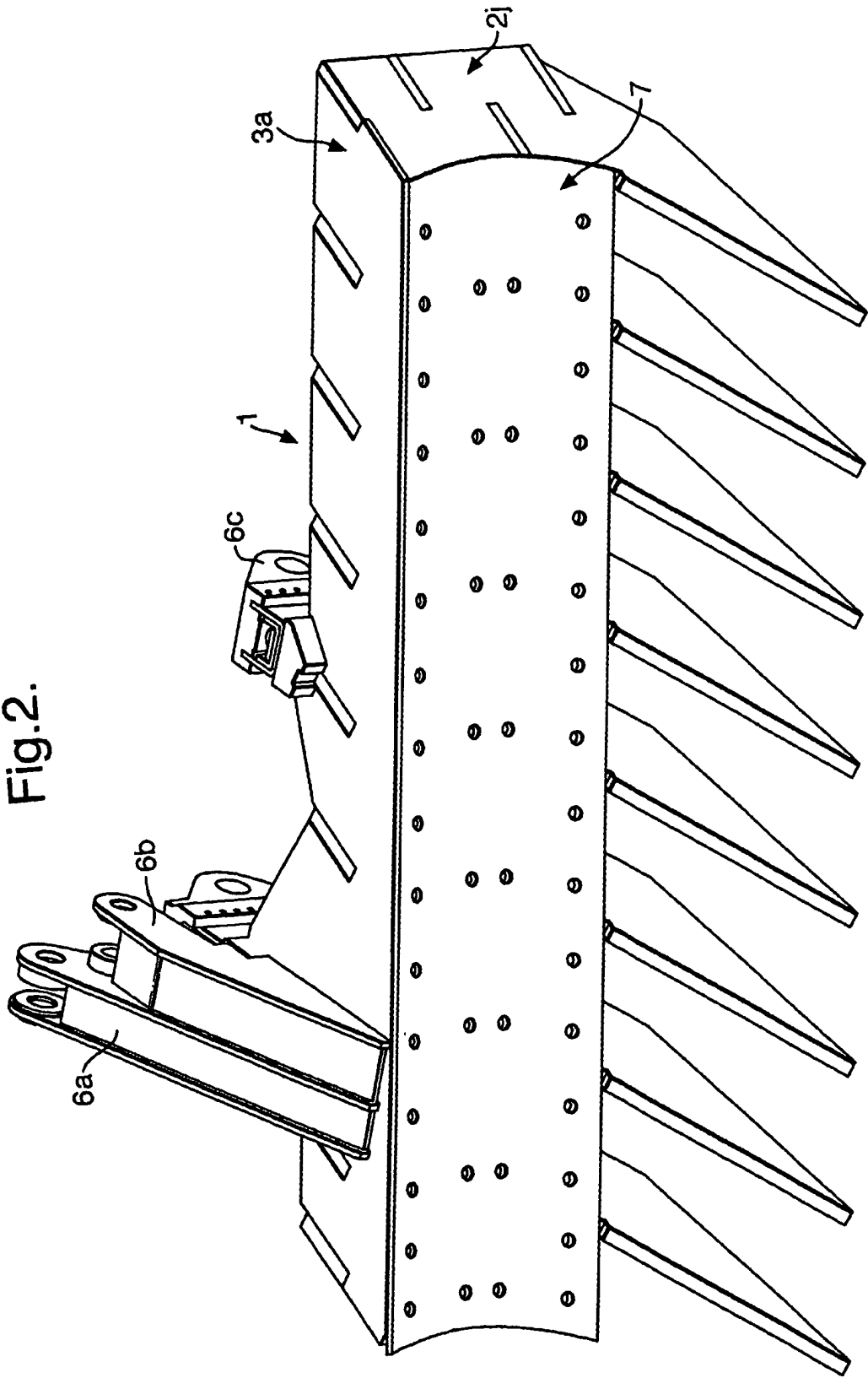
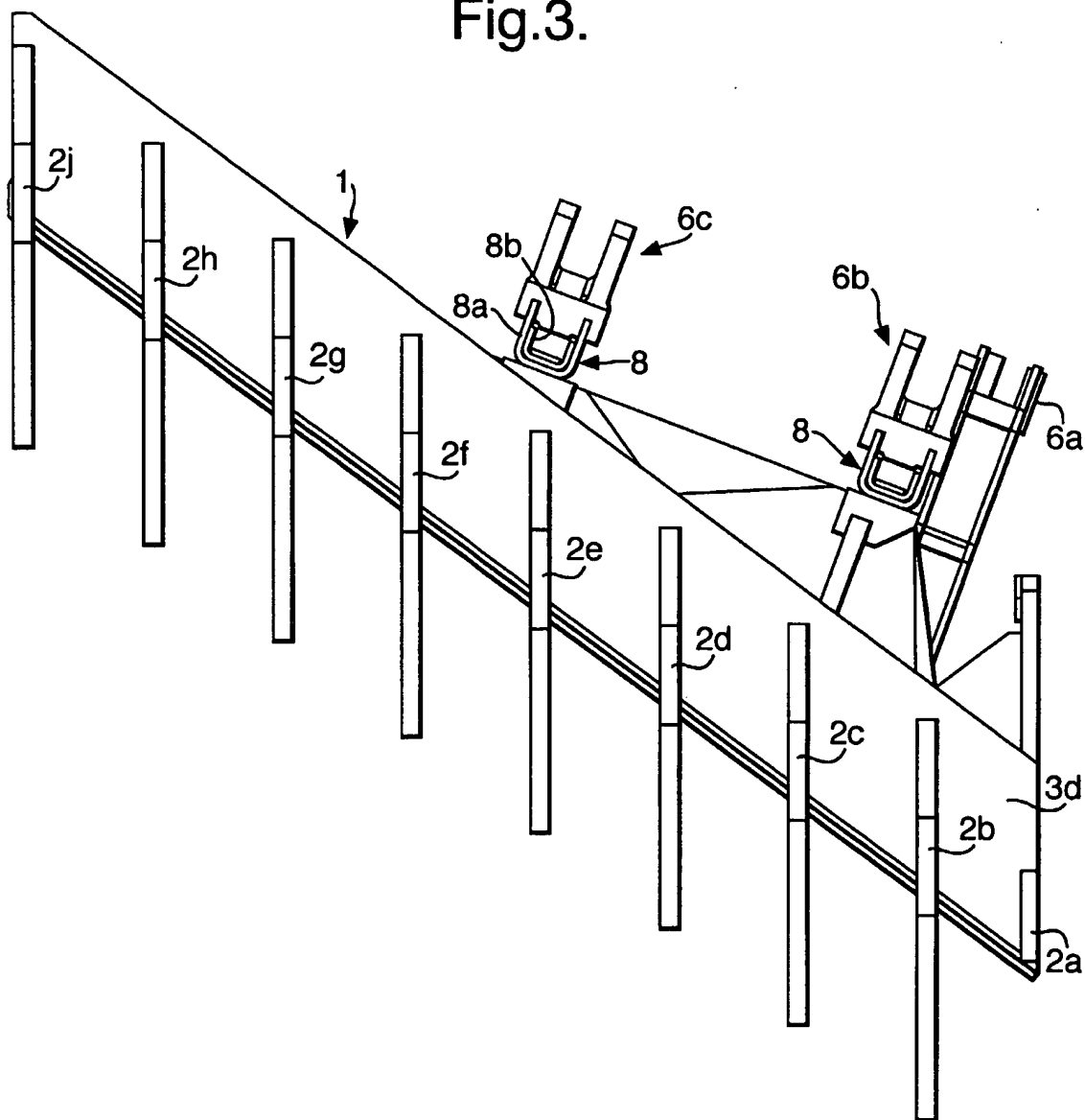


Fig.3.



# INTERNATIONAL SEARCH REPORT

Internal	Application No
	PCT/GB 02/05937

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 F41H11/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 F41H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 189 243 A (HAMBRIC) 23 February 1993 (1993-02-23) column 4, line 39 - line 54 column 5, line 8 - line 12; figures 3,4 ---	1-4,7,8, 11
Y	WO 99 46554 A (BOFORS) 16 September 1999 (1999-09-16) page 8, line 22 - line 26; figures 2,4-6 ---	1-4,7,8, 11
A	US 5 198 608 A (CAHILL ET AL.) 30 March 1993 (1993-03-30) column 6, line 44 - line 65 column 8, line 3 - line 17; figures 1,9,11 ---	1-4,7,8, 11
A	US 5 313 868 A (WOLF) 24 May 1994 (1994-05-24) column 5, line 64 -column 6, line 14; claims 7,15; figure 5 ---	1,9,10
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

15 April 2003

Date of mailing of the international search report

25/04/2003

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# INTERNATIONAL SEARCH REPORT

Intern: Application No  
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 453 011 B (BOFORS AB) 4 January 1988 (1988-01-04) figures 4-6	1-8
A,P	WO 02 066919 A (QINETIQ) 29 August 2002 (2002-08-29) page 3, line 11 - line 13	1



# INTERNATIONAL SEARCH REPORT

relation on patent family members

Internation Application No  
PCT/GB 02/05937

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US 5189243	A	23-02-1993	NONE	
WO 9946554	A	16-09-1999	SE 511676 C2 EP 1062474 A1 SE 9800765 A WO 9946554 A1	08-11-1999 27-12-2000 11-09-1999 16-09-1999
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## TITLE OF INVENTION

**MINEPLOUGH**

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

The present invention relates to a novel form of blade for a mineplough.

## 2. Discussion of Prior Art

A mineplough may be defined as the apparatus fitted to a (preferably robust) vehicle so as to create a system for effecting clearance of a path through a minefield. In particular this mode of mine clearance is appropriate for use in a wartime situation where a rapid clearance of anti-tank mines is operationally vital because it is recognised that, in these circumstances, some damage is likely to be sustained by at least the mineplough part of the system.

The main mechanical components of a mineplough are:

- i) a blade which comprises:
  - a) tines which are teeth mounted on the blade and which cut into the ground so as to lift the earth and any buried mines; and
  - b) the mouldboard which is the part of the blade that pushes the lifted earth and mines to the side of the vehicle path to clear a lane for following traffic;
- ii) a linkage system which is the mechanism connecting the plough to the carrier vehicle; and
- iii) a depth control system, the function of which is to try and ensure that the tines maintain a constant depth of cut. It usually comprises ground following skids which react against the vertical forces produced during ploughing.

In clearing a path through a major minefield it is recognised that up to 5 mines in total may have to be cleared and if, for example, these are fitted with anti-disturbance fuzing, this may mean up to 5 mines exploding during the clearing operation. To achieve a speedy clearance it is desirable that only one mineplough be actually involved in the operation but with current designs of mineplough it is not possible to attain the level of robustness which is required to achieve this.

## SUMMARY OF THE INVENTION

It is therefore a primary objective of the invention to provide a mineplough which is sufficiently robust to withstand the blast from one or more typical anti-tank mines and yet continue to operate fully effectively.

The particular areas of weakness of current designs lie in the blade itself and most particularly in the linkage between the blade and the carrier vehicle. Accordingly the present invention seeks to provide a mineplough having both a blade and a linkage system which are more resilient towards high shock loadings that can be created by a mine exploding against any part of the mineplough. The invention therefore provides a mineplough which comprises at least one blade element which is set at an angle to the general direction of movement of the plough so as to deflect lifted earth to one or both sides of the plough, tines attached to each said blade element so as to lift earth ahead of that blade element in the direction of travel thereof, depth control means for controlling the depth of cut of the tines and at least two linkages for connecting the mineplough to a suitable carrier vehicle therefor, characterised in that each blade element is comprised of a plurality of intersecting plates whose planes lie substantially parallel to the said direction of travel and which define open channels therebetween and further characterised in that the linkages each contain at least one crushable element capable of absorbing blast shock.

By providing a generally open structure to the mouldboard, the soil and other blast products which are thrown up by a mine exploding ahead of or on contact with a tine are vented through the blade to a high degree thus lowering the loading on the connecting linkage in particular. Further by providing a structure with considerable depth perpendicular to the blade face, the blade is extremely strong and this, coupled

with the relatively small surface area which is presented to blast products by the edges of the intersecting plates, means that the blade structure is highly resistant to damage. Typically the depth of the blade in the direction of its travel will be of the order of 150 mm.

The blade channels defined by the intersecting plates should be relatively narrow such that in operation the channels will tend to clog up with soil and hence ploughing action will be maintained. In any event the channels should be of such dimensions as to ensure that any anti-tank mine will be unable to pass through the blade. Advantageously, however, the vented blade structure is faced on its front surface with a relatively weak covering plate which will act as a normal mouldboard during ploughing but at the same time is able to absorb some of the blast effect should a mine explode adjacent to the blade. However, the covering plate should only be of such strength that it will fail, at least locally, without causing sufficient resistance to the blast as to allow damage to be caused elsewhere in the system (and particularly to the linkage). Although even a first blast may thus cause a substantial disruption to the covering plate (mouldboard) this is likely only to be within an area adjacent to the seat of the explosion and the protective effect of the plate is unlikely to be totally lost even after a number of mines have exploded. Apart from that, as mentioned earlier, even where some of the blade channels through the blade structure have become exposed through degradation of the covering plate, it is likely that, in operation, they will block up with soil and thus a degree of blast resistance will remain even with those channels (as well of course for those areas of the blade which remain protected by undamaged portions of the covering plate).

Advantageously, the structure of the blade comprises a plurality of plates disposed in a substantially vertical arrangement and a further set of plates intersecting these and arranged in a substantially horizontal manner. The spacing of the plates in both dimensions should be such as to ensure that no mine which is likely to be encountered will pass through any of the channels defined by the sets of plates and also such as to ensure that the blade has a sufficient overall strength, while being at the same time sufficiently far apart that the blast venting effect of the blade structure of the invention is maintained. When the plates are arranged in this manner a further advantage of the blade structure of this invention can be achieved by arranging that

the tines are formed by an extension of the vertical plates of the blade structure and are thus integral with the rest of the blade. This gives the tines additional strength and resistance to disruption.

Preferably the tines are further strengthened by providing them with bracing pieces which are attached between pairs of adjacent tines. Such bracing members should be relatively thin in the direction of travel of the blade so as to present little or no interference to the blade ploughing action. For the same reason, it is also preferred that the bracing members be set back from the front edges of the tines to which they are attached.

The two sets of intersecting plates described above may conveniently each have co-operating slots provided in them so that, to assemble a blade element, the respective plates are simply slid together to interlock. The plates are then welded together along the length of each intersection using a large section fillet weld (typically 20mm).

The mineplough may comprise either a single angled blade element or may comprise two blade elements forming a V-shaped blade overall, depending on the size of clearance path required, the nature and effective power of the carrying vehicle used, the nature of the terrain etc.

The linkage of the mineplough of this invention has a crushable element which acts to absorb some of the forces which would otherwise be transmitted from the blade through the linkage to the carrier vehicle and which could otherwise cause the linkage to fail. In particular the pins (termed the "boom arm pins") which allow for motion of the blade at an angle to the direction of travel are likely to suffer from high levels of stress if the blade is subject to a mine exploding at close range and this could cause the pins to fail in shear.

The crushable element suitably comprises a series of substantially U-shaped channel members located ahead of the boom arm pins in the direction of travel of the blade (i.e. between the blade and the boom arm pins which the members are intended to protect). The channel members are designed to crush under a loading which is

below the shear strength of the boom arm pins. For additional resilience and to achieve better lateral stability of the blade, two sets of channel members could be provided, one of which sets is positioned vertically and the other set of channel members positioned horizontally with respect to the blade. In an alternative arrangement, the channel members could be replaced with a series of short tubes designed to crumple under a shock load and so to act as energy absorbers and it will be readily apparent to the skilled addressee that other means of providing the desired resilience in the linkage system can be contemplated and are to be understood as falling within the scope of the invention.

### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described with reference to the accompanying drawings in which:

Figure 1 is a three dimensional view of a single angled mineplough blade according to the invention;

Figure 2 is a similar view of the same blade as shown in Figure 1, but having a covering plate (mouldboard) attached; and

Figure 3 is a plan view of the same blade as shown in Figure 1 looking from the underside of the blade and showing in more detail a part of the linkage to the carrier vehicle.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figure 1 there is shown a mineplough 1 which comprises a set of 9 vertical plates (2a to 2j) and a further set of four horizontally-disposed plates (3a – 3d) constituting the mouldboard. It can be seen that all but one of the vertical plates are extended downwards and forwards of the blade to form a series of tines, 5b – 5j. The plates are conveniently made from steel, for example, Rolled Quenched Tempered (RQT) 701 (a product of Corus Ltd) or a Rolled Homogeneous Armour material. In the case of RQT701 a suitable thickness will be of the order of 20mm for the horizontal plates and 25mm for the vertical plates. Three connecting members 6a, 6b,

6c are attached generally at the rear of the blade for connecting it to the linkage (not shown). (It will be noted that the horizontal plates to which these connecting members are attached are extended outwards towards the connecting members in order to strengthen the plates in the area where the two are connected). A U-shaped channel member 8 is shown generally associated with the connecting member 6c.

In Figure 2 there is shown the same blade as in Figure 1 except that the front face of the blade is now covered with a thin facing plate 7. This plate may be made from steel of 4mm thickness or may comprise a plate of 5 or 10mm thickness of high density polyethylene but it will be readily appreciated that the materials to be used will be dependent to some degree on the size of the openings in the blade structure and on the strength of the linkages among other factors.

Figure 3 shows in greater detail the linkage arrangements of the blade shown in Figures 1 and 2 and the same parts are identified by use of the same numerals as for those Figures. In this drawing the lower ends of vertically-disposed U-shaped channel members 8 associated with both of the connecting members 6b and 6c are shown. Each channel member comprises two channel pieces, 8a and 8b, of which one is housed within the other and provides support once the outer pieces have distorted under a shock load. In this way the channel members can successfully absorb the blast energy from two mines exploding against the blade and protect the linkages from damage.

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